

REMARKS

In a final Office Action dated September 26, 2008, the Examiner rejected claims 6-9 and 20-26 under 35 U.S.C. §102(e) as anticipated by Buyya et al., “A Deadline and Budget Constrained Cost-Time Optimisation Algorithm for Scheduling Task Farming Applications on Global Grids” (herein *Buyya*). Applicant subsequently filed an amendment, correcting a minor typographical error in one claim, and traversing the rejection. By Advisory Action dated January 23, 2009, the Examiner indicated that the amendment would not place the application in condition for allowance.

Applicants have cancelled claims 20-22 in the interests of simplification. Although applicants do not necessarily concede the correctness of the Examiner’s rejections for the reasons stated in the previous amendment, applicants have decided to amend the remaining outstanding claims in the interests of furthering prosecution herein. Additionally, applicants have decided to re-assert certain apparatus claims which were previously cancelled herein with the intention of placing the cancelled subject matter in a continuation application. That continuation application has not yet been filed, and applicants at this time do not intend to file such a continuation. The re-asserted apparatus claims (claims 29-40) have been re-asserted in altered form consistent with the amendments to the method claims herein. Applicants have further added new method claims 28 and 41-43. Dependent claim 28 recites additional subject matter similar to that recited in previous independent claim 20, now cancelled. Independent claim 41 recites in greater specificity the aspect of iteratively assigning work items to a data processing system (such as an in-house system) and selectively contracting out remaining work items. Dependent claims 42 and 43 recite matter similar to that of dependent claims 8 and 28. No new matter is introduced.

As explained previously, applicants’ invention relates to the scheduling of computer resources in an environment where at least some of the resources are fee-based. The exemplary

embodiment involves a fee-based distributed computing system (grid system), in which computing resource can be purchased on demand. The fees for purchasing resource could vary by time of day and/or day of week, or according to how busy the system is or other factors. A local computer system or network, such as an in-house computer system within an enterprise, might provide a limited amount of processing capability and be connected to the fee-based computing system for additional computing capacity. Other variations of this exemplary embodiment are possible.

In such an environment, it is possible to simply purchase additional computing resources from the fee-based system whenever there is a job in need (i.e., demand which can not be met by the available in-house or other free resources, to the extent there are any). However, this involves additional cost, when by waiting it might have been possible to execute the same job using available in-house or other free resources, or to execute the same job at a lower cost from the fee-based system. At the same time, if execution is deferred whenever a fee is involved, or whenever a fee in excess of a standard rate is exceeded, it is possible that some high-priority jobs will be deferred and cause unwanted consequences in excess of the fee that would otherwise have been charged.

Applicants recognize that not all jobs are equal. For each job, there is some theoretical corresponding value associated with having it done now as opposed to later. Applicants therefore define a corresponding valuation for each job to the computer system, and to compare these valuations to the projected fee for processing the job now. If the fee exceeds the value, the job is deferred; if not, the job is scheduled for processing, and the resultant fee is incurred. This valuation is specific to the job, it being expected that the valuations will vary. Variation in valuation may cause some jobs to be deferred, while other more valuable jobs are allocated the fee-based resources necessary for execution now, notwithstanding the additional fee involved.

By deferring less “valuable” jobs, greater flexibility is achieved to process these jobs at a time when the fees are lower, or when in-house computing resources are idle so that no fee is required.

Therefore a significant feature of applicants’ invention is that *a respective valuation* is associated with each of a plurality of work items, and that this *valuation is compared to a respective cost* of the computing resources required to do the work, and that the scheduler *selectively accesses the resources or defers processing (and repeats)* based on this comparison. Applicants’ representative claim 6, as amended, recites:

6. A computer-implemented method for managing access to computer resources, the method comprising:

(a) *defining a respective valuation of each of a plurality of work items* to be processed by one or more data processing systems;

(b) *comparing the respective valuation of each respective said work item* to a respective cost of accessing additional computer resources necessary to process the work item in a current time period;

(c) with respect to each said work item for which the *respective valuation of the work item exceeds the respective cost* of accessing additional computer resources necessary to process the work item in the current time period, *dynamically accessing additional computer resources necessary to process the work item in the current time period*;

(d) with respect to each said work item for which the *respective valuation of the work item does not exceed the respective cost* of accessing additional computer resources necessary to process the work item in the current time period, *deferring processing of the work item to a subsequent time period*; and

(e) *repeating said (b) through (d) in one or more subsequent time periods* with respect to each said work item deferred by said (d) until each said work item has been processed. [emphasis added]

The remaining independent claims vary in scope, but all contain limitations analogous to the italicized limitations above.

As explained previously, *Buyya* discloses a job scheduling mechanism for use in a scheduling jobs to execute in a fee-based distributed computing environment. A resource broker acts as an intermediary between a user having multiple jobs requiring execution and distributed

computer resources capable of processing the jobs. The resource broker discovers the availability and cost of computing resources from diverse sources, and schedules the jobs for execution on one or more computing resources in such a way as to optimize both cost and time of completion. *Buyya* discloses that a user can specify an overall budget and deadline for multiple jobs. The resource broker schedules jobs on the available resources to complete within the overall deadline at lowest possible cost, not to exceed the budget.

In the previous amendment filed after final rejection, applicants argued that *Buyya* does not show assigning costs to individual jobs (work items), but only has an overall budget. The overall budget is essentially a fail-safe mechanism, to prevent the scheduler from automatically bankrupting its client. *Buyya* does not deal with the issue of what is to be done if the budget is exceeded. Exceeding the budget merely terminates the process, and the user will have to deal with any unprocessed jobs at that point.

Applicants' invention, on the other hand, is directed to an iterative process, whereby work items are scheduled in multiple time periods, and may be deferred to subsequent time periods based on valuations of the work items themselves. Specifically, some work items having a higher valuation may demand that additional resources be bought at significant expense in order to compete the work item sooner rather than later, while others will not have such a high priority and can be deferred, either until such time as there is available processing capability in-house, or the cost of purchasing the computing resources externally is lower (e.g., at off-peak hours).

Buyya does not disclose or suggest this temporal aspect of scheduling. *Buyya* simply goes into the computing world at a given time, locates the lowest cost resources, and schedules the available jobs to use the lowest cost available resources at that time. The "budget" simply acts as a limit on how much can be spent, but it is not associated with individual work items, and

reaching a budget limit simply causes the further scheduling of jobs to abort. At this point, manual intervention would be necessary.

For all the reasons stated above, and in the previous amendment of November 26, 2008, filed in response to the final rejection, the claims are patentable over the cited art.

In view of the foregoing, applicants submit that the claims are now in condition for allowance and respectfully request reconsideration and allowance of all claims. In addition, the Examiner is encouraged to contact applicants' attorney by telephone if there are outstanding issues left to be resolved to place this case in condition for allowance.

Respectfully submitted,

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